2.2 WJEC Answers

1.

(a) (i) Actively transported into the guard cell [1]
(**allow**: pumped in)
to increase turgor or decrease water potential [1]

(ii) Outer walls thinner than inner walls [1]
(**not**: difference in thickness)
turgor pushes outer wall outwards to open stomata [1]
(**not**: guard cells change shape)
(mention of turgor required in either i or ii)

(b) Light / water deficiency (humidity) / temperature /

carbon dioxide. [2]
(**not**: ref. to windspeed/daytime/night time)

[Total mark 6]

2.

(a) A Name – palisade mesophyll/palisade cell;

Function – traps (sun)light / energy (for photosynthesis); [2]

B Name – vascular tissue or bundle / xylem/ phloem;

Function – transport water / sucrose / amino acids/products of photosynthesis. [2]

(b) (i) xerophytes [1]

(ii) three points on diagram, lines must point to a feature e.g.

thick epidermis;

sunken stomata;

hairs surrounding stomata;

thick cuticle; [3 max]

(iii) reduces (surface) transpiration or evaporation of water;
(not: reduced transpiration)

shell of water vapour/moist air accumulates;

prevents movement of water vapour/moist air/retains water vapour;

prevents water passing through; [3 max]
(not: water/moisture) (allow: consequential error)

[Total marks 11]

3.

(a) Thin/short diffusion pathway; permeable; moist; has a conc. gradient;
(Max 3)(not: porous/ref capillary network/ ref flat shape) [3]

(b) (i) label line touching end of tracheole where they touch muscle
(not: just letter); [1]

(ii) Fast (oxygen 200,000 x faster than blood, carbon dioxide 10,000 x);

No respiratory pigment/haemoglobin required;reduced water loss;

oxygen supplied directly to tissues/no transport system needed:

(Max 2) (not: large surface area unqual) [2]

(iii) $\frac{\text{Difference}}{\text{Original}} \times 100$ [1]

Answer 50(%); [1]

(c) Intercostal muscles contract;

ribs upwards and outward;

diaphragm contracts/flattens;

volume increases;

pressure decreases;

Below atmospheric pressure
(Max 4) [4]

(d) (i) Water contains <u>less</u> oxygen than air; pp oxygen varies with temperature;

diffusion rates much slower;

Dense/viscous medium more difficult to pump/move;

(Max 2) [2]

(ii) *Parallel flow,* water and blood in gills flow in same direction; [1]

Counter current, water and blood flow in opposite directions; [1]

Concentration gradient maintained over entire distance travelled by

water over gills; [1]

4.

(a) Large surface area / thin or short diffusion pathway / permeable / good blood supply
(moist neutral; wrong answer negates right answer; not: ref. contraflow)
(Any three) [3]

(b) On diagram B label water (upper plot) and blood (lower plot) with arrows pointing left to right on both [1]

Water plot starts high on Y axis (90-100%) and blood starts low (20%) [1]

Convergence point is at 50%. [1]

(c) X = distance along lamella / gill plate (not gill). [1]

(d) Blood saturation reaches higher level. [1]

Uptake continues (water concentration higher than blood) throughout/ concentration gradient maintained. [1]

[Total 9 marks]

5.

(a) (i) Drawing showing 2 guard cells curved and pore open AND drawing showing guard cells inner edge straighter and pore closed (1);
Wall adjacent to pores thicker (1). Touching top + bottom 2

(ii) Chloroplasts. (right + wrong = 0) 1

(b) Stomata will be open to allow carbon dioxide in / gas exchange for photosynthesis. 1
closed at night to avoid water loss. / transpiration reduced 1

(c) 1. K^+ / Potassium ions pumped into guard cell (by active transport)
(not: diffused)
2. Starch to malate.
3. Solute/ water potential in the (guard cells) lowered. (not: WP)
4. Water moves in by osmosis / down a water potential gradient
5. (Turgor increases) as cells expand they curve/bend (because inner walls are thicker than outer walls)
[4/5] 4

9 MARKS

6.

(a) Thoracic spiracles open first / just before abdominal spiracles
Abdominal spiracles open as thoracic spiracles close.
Abdominal spiracles close just after the thoracic spiracles.
Abdominal spiracles open for the same length of time as thoracic spiracles
(Any 2) **[2]**

(b) (i) Thoracic spiracles open when the abdomen expands **[1]**
Abdomen is compressed before abdominal spiracles open **[1]**

(ii) Acting as a pump to draw air in via the thoracic spiracles, **[1]**
through the system and forces it out via the abdominal spiracles. **[1]**

(c) Excessive water loss prevented / rapid dehydration if spiracles left open. **[1]**

[Total 7 marks]

7.

(a) A Guard cells 1
B Epidermis/al cells (not: epithelium) 1

(b) Allow gas exchange/CO_2 / O_2 to enter and leave the leaf 1

Control water (vapour) loss 1
(allow: prevents water loss qual. e.g. by closing at night
not: allows transpiration)

(c) Active transport/ pumping of K^+ ions into the guard cells and starch-malate 1

conversion **lowers** Ψ 1

Water flows in by <u>osmosis</u> or down a water potential gradient 1

Guard cell becomes <u>turgid</u> 1

<u>Inner</u> wall of guard cell is inelastic/thicker

so guard cells curve /bends away from each other

(d) Cyanide stops respiration/is respiratory inhibitor/stops ATP synthesis 1
Stopping <u>active transport</u> (of K^+) into (guard) cell 1

Total 10 marks

8.

(a)		Thin – small diffusion distance; Accept small diffusion distance/ pathway Large surface area- (large contact with air) for diffusion/ gas exchange/ OWTTE; Moist- allow gases to dissolve/ gases go into solution (to cross membrane); Not diffuse into Permeable-to allow gases to pass through (the respiratory surface); NOT blood supply	3 max
(b)	(i)	Through {(general) body surface/skin}; NOT gills	1
	(ii)	Fast flowing; maintains {concentration/ diffusion} gradient/absorbs more oxygen at surface/ OWTTE;	2
	(iii)	They dry out/ unable to remain moist/ lose water; They clump together (because of surface tension.)/ collapse/ lie on top of each other;	2
(c)		Blood flows (across gill) in opposite direction to water; NOT different direction {Concentration/ diffusion} gradient is maintained across whole surface/ {concentration/ diffusion} gradient is maintained constantly/ blood always meets water with a higher oxygen concentration/ equilibrium is never reached ; NOT concentration gradient maintained for longer/ maintains a high concentration gradient A greater concentration of oxygen in the blood is achieved/ allows more oxygen to diffuse in/ higher % saturated blood/ allows more {diffusion/ exchange} of gases/ more take up of oxygen/ ORA; NOT makes it more efficient alone	3
		Question 2 total	**[11]**

9.

			Available
(a)		Any 4 Intercostal muscles <u>contract</u> <u>and</u> ribs move <u>up and out</u>; Diaphragm (muscles) <u>contract</u> and diaphragm <u>flattens</u>; (Internal) volume of <u>thorax</u> increases; accept chest reject lungs Pressure in lungs/ thorax decreases; {High<u>er</u>/ <u>difference</u> in} air <u>pressure</u> outside {forces/ pushes/ moves/ drawn} air into lungs;	4
(b)	(i)	blood flows across (gills/ filaments/ lamellae/ gill plates) in opposite direction to water; water always has more oxygen than blood/ (oxygen) {diffusion/ concentration} gradient maintained; oxygen passes from water into blood; across entire {gill/ gas exchange} surface; NOT longer higher saturation of blood with oxygen/ more oxygen taken up;	4
	(ii)	Parallel (flow);	1
	(iii)	Equilibrium is reached (part way across the gill plates/ lamellae)/{diffusion/ concentration} gradient not maintained; {Lower percentage saturation with/ <u>only</u> 50% saturation} oxygen/ less oxygen uptake/ less diffusion of oxygen; NOT slower	2
(c)		gills dry out; prevents oxygen from dissolving on surface of gills; gills may {stick together/not open as easily/ collapse}; decrease in surface area; (Explanation cannot be accepted alone)	2 max
		Question 3 Total	**[13]**

10.

(a) The movement of ions / molecules / particles from a region where they are in high concentration to a region of lower concentration / along a concentration gradient from high to low (until concs. are equal) / down a concentration gradient. (1)

(b) *Amoeba* - (being small or unicellular) provides a large surface area to volume ratio / gases have a short diffusion path. (not: ref. to metabolic rate) (1)

Planaria - (although multicellular) these organisms are flat and so have a large SA / vol ratio / each cell is close to the surface / shorter diffusion path. (1)

(c) (i) Doubling the length results in a halving of the ratio / the size of the ratio is inversely proportional to the length. (not: restating figures) (1)

(ii) I. alveoli. (1)

II. As the mammal is large it has a small surface area to volume ratio;
therefore diffusion paths are long / diffusion is slow;
(not: diffusion not adequate)
alveoli needed to increase surface area (to allow efficient gaseous exchange).
(Any 2 out of 3) (2)

(Total 7 marks)

11.

(a) (i) A = alveoli:

B = bronchiole
(not: bronchi) [2]

(ii) emphysema; [1]

(walls of) alveoli broken down (not: damaged);

alveoli (merged to) form large space/reduced number of alveoli;

walls of alveoli thicker
(not: lose elasticity/reduced surface area for gas exchange) [2 max]

(iii) smaller (overall) area for gaseous exchange;

less oxygen absorbed;

by diffusion/longer diffusion pathway;

loss of elasticity reduces recoil/lungs remain inflated in correct context [2 max]

12.

	Inspiration	*Expiration*
External intercostal Muscles	Contracted	Relaxed
Movement of ribcage	Up and outwards	Down and inwards
diaphragm	Contracts (flattens)	Relaxes (dome shaped)
Volume of thorax	Increases/high	Decreases/less
Pressure in thorax	Decreases/less	Increases/high
Direction of movement of air	In (to lungs)	Out (of lungs)

One mark per row. 6

13.

(a) (i) Large surface area / thin or short diffusion distance / moist / good blood supply / permeable to gases. 2
(Any 4 for 2, 3 correct award 1, <3 award 0)
(not: ventilation mechanism/thin cell walls)

(ii) Infolding reduces heat loss; Infolding reduces water loss; Protection (by ribs) (Any 2) 2
(not: ref. to pressure differences)

(b) (i) Move respiratory medium over respiratory surface / bring in oxygen / remove CO_2 1
To maintain concentration gradient 1

(ii) Diaphragm 1
Intercostal muscles 1

(iii) Blood flow correctly drawn and labelled in gill plate 1
Water flow correctly drawn and labelled between plates 1

(iv) Counter current 1

(v) Enables exchange to occur over whole of gill plate / Maintains concentration gradient 1
(allow: longer time in correct context)

[12]

14.

(a) (i)
A. Epiglottis 1
B. Cartilaginous rings/cartilage 1
C. Diaphragm 1
D. Bronchioles 1

(ii)
A. (Closes entrance to trachea) to prevent inhalation of food. 1
B. Prevent collapse of air passages (as pressure falls to draw in air). 1
C. Lowered by muscles to increase volume of thorax/lowers pressure. (not: contracts to change volume/moves up and down for inspiration) 1

15.

(a) 1:1; 2

0.75:1/3:4/1:1.3;

(b) ratio of surface area to volume large;

diffusion sufficient to meet requirements/shorter diffusion path;

oxygen for respiration/removal of carbon dioxide;

as cells/organisms become larger, surface area to volume ratio smaller;

diffusion can't supply oxygen/nutrients/remove carbon dioxide; 3 max

(comparison needed)

[5]

16.

(d) (i) solid line – water, broken line - blood 1

(ii) A

(iii)

	System A	System B
maximum difference in amount of oxygen, between blood and water	1	8
the distance along the gill plate over which exchange is possible	7	4
the maximum amount of oxygen in the blood	8	5/4.9

1 mark for each correct row 3

(e) (i) A/counter current 1

(ii) whole surface used/greater final level of oxygen in blood/ maintains diffusion gradient 1

Essays

1.

(b)	A.	all gaseous exchange takes place by diffusion across a thin membrane; (**not**: short diffusion pathway)	[1]
	B.	this alone will supply all body cells only if the animal is very small / very thin and flattened;	[1]
	C.	mention of single celled organism/Amoeba/flatworm;	[1]
	D.	mention of surface area / volume ratio	[1]
	E.	maintenance of concentration gradients across membrane (O_2 in and CO_2 out);	[1]
	F.	earthworm – long, tubular shape provides large surface / volume ratio;	[1]
	G.	blood transport necessary to maintain diffusion gradients/transport oxygen to tissues where required;	[1]
	H.	adequate exchange areas in fish provided by gills;	[1]
	I.	respiratory movement to provide flow over gills;	[1]
	J.	counter current flow explained;	[1]
	K.	terrestrial animals must have internal exchange surface;	[1]
	L.	respiratory movements to aid gas exchange;	[1]
	M.	(many branched) lung structure giving large surface area of alveoli;	[1]
	N.	where exchange takes place;	[1]
	O.	double circulation specialised for gas exchange/role of respiratory pigment i.e. picks up oxygen and increases uptake at respiratory surface.	[1]

[Total of 10 marks can be awarded out of 15]

2.

(b) (i) A = large surface area to volume ratio;

B = moist surface / epithelium/membrane/covered in mucus;

C = earthworm blood vessels under/close to skin surface;

D = ref to blood pigments;

E = thin / permeable epithelium/membrane;

F = short diffusion pathway; (not: diffusion unqual)

G = low metabolic rate; [5 max]

(ii) H = external intercostal muscles contract;

I = ribs move up and out;

J = contraction of diaphragm (muscles)/ diaphragm flattens;
(not: diaphragm moves down)

K = volume of thorax increases;

L = decreases pressure in lungs/thorax;

M = air pressure outside is higher;

N = air forced/drawn into lungs; (not: moved)

O = ref to role of pleural membranes; [5 max]

[Total 10 marks]

3.

(a)

A	Leaves (are flat) and have large surface area to <u>absorb</u> maximum light/CO_2/gas exchange	1
B	Leaves can grow towards/orientate with light/sun to expose maximum area.	1
C	Leaves thin to allow light to penetrate to lower layers.	1
D	Cuticle and/or epidermis are transparent to allow light to penetrate to mesophyll.	1
E	Palisade cells elongated to reduce number of cross walls to absorb light.	1
F	Palisade cells packed with chloroplasts to increase photosynthetic capacity/light absorption.	1
G	Chloroplasts can move/circulate inside cells to gain best positions for absorbing light.	1
H	Spongy mesophyll cells are moist/wet surface or have large surface area for gas exchange/absorption of gases.	1
I	Xylem to supply water and/or phloem to remove sugar.	1
J	Leaves thin (i.e. overall thickness) to reduce distance for diffusion.	1
K	Air spaces in spongy mesophyll allow circulation of gases/ cut down distance for diffusion into cells/gradient for uptake.	1
L	Stomatal pores permit entry and exit of gases/sub stomatal/intercellular spaces in spongy mesophyll allow supply of carbon dioxide and removal of oxygen/gas exchange between outside and inside leaf.	1
M	Waxy cuticle on upper surface reduces water loss (by evaporation) or waterproofs the leaf.	1
N	Stomatal pores in <u>lower</u> epidermis reduce water loss (by evaporation).	1
O	Guard cells can close stomatal pores/control opening to reduce water loss.	1

(allow: ecf for ref. 'traps' light or 'stops/prevents' water loss) **10 MAX**

4.

(b)

A.	Leaf is flat and thin / large surface to volume ratio.	[1]
B.	Large surface area for light trapping.	[1]
C.	Thin to give short diffusion distance into leaf.	[1]
D.	Transparent epidermal layer.	[1]
E.	Covered by cuticle.	[1]
F.	Prevents water loss.	[1]
G.	Palisade mesophyll - vertically arranged packed cells or contain abundant chloroplasts.	[1]
H.	Arrangements gives maximum light absorption.	[1]
I .	Spongy mesophyll with large intercellular spaces.	[1]
J .	Allows room for movement of respiratory gases and water vapour.	[1]
K.	Diffusion of gases in and out of leaf through stomata.	[1]
L.	Stomatal pore surrounded by two guard cells.	[1]
M.	Change in water potential / pressure bends guard cells to open stomata.	[1]
N.	This change is related to photosynthetic activity so gas exchange only occurs when it is required.	[1]
O.	Closure at other times prevents water loss.	[1]

5.

(a) General re any examples

A Large S.A. qualified e.g.
B Moist surface for diffusion e.g.
C Short diffusion pathway qualified e.g. thin walls etc.
D Circulatory system with blood pigments/haemoglobin
E Internal lungs minimise loss of water / heat (not: in reference to frogs)
F Ventilation mechanism / or description e.g. ref insect abdominal movements
G Ensures fresh oxygen is brought to /carbon dioxide removed from gas exchange surface/maintain concentration gradients.

<u>Frogs</u>

H Inactive (frog) amphibian uses its moist skin for gas exchange
I Active (frog) amphibian uses lungs
J tadpole stage uses gills

<u>Reptiles and birds</u>

K More efficient lungs than amphibians
L Air sacs act as bellows

<u>Insects</u>

M Have a branched chitin lined system / presence of tracheae
N With openings called spiracles;
O Gases exchange directly with tissues/No blood pigment/ haemoglobin present

6.

Explain why large, multi-cellular organisms have evolved specialised surfaces for gaseous exchange.		3
Describe and explain how terrestrial mammals are adapted for gaseous exchange in air.		7
A	metabolic needs (approx) proportional to volume/ larger organisms need more oxygen	
B	Larger organisms external surface insufficient for gas exchange	
C	diffusion (of respiratory gases) proportional to surface area	
D	surface area : volume ratio is too small/ larger animals have a smaller SA:vol ratio (to supply metabolic needs)	
E	diffusion distances too large	
F	not enough O_2 can diffuse / O_2 cannot diffuse fast enough (to the cells furthest from surface) (to meet metabolic needs)	
G	{gas exchange surface folded/ large number of alveoli} - to increase surface area	
H	internal lungs	
I	(to) reduce water / heat loss NOT prevent	
J	gaseous exchange takes place in the alveoli	
K	thin walls - reduce diffusion distance	
L	(layer of) moisture – for gases to dissolve in	
M	blood supply/ capillaries – {maintain concentration / diffusion gradient (between alveolar air and blood)/ transport absorbed gases}	
N	haemoglobin (in erythrocytes) – transport of oxygen	
O	ventilation mechanism/ description of ventilation mechanism	
P	(to) replace stale air with fresh air / enable continuous exchange of gases	max 7
	Question Total	**10**

7.

(b)

A. Pores in the leaf epidermis, bordered by guard cells

B. Inner wall thicker than outer

C. Presence of chloroplasts

D. (Fully labelled) reasonable diagram

E. GC change shape to allow opening and closing/labelled diagrams

F. Allow gas exchange

G. Control loss of water vapour from leaf

H. **Opening** = K^+ pump actively transports K^+ ions into GC (not: ref. stomata)

I. PS causes CO_2 levels to fall/pH rises

J. and (enzyme catalyses) the conversion of starch to malate

K. K^+ and malate ions/solutes accumulate in GC

L. Ψ cell is lowered (i.e. ref water potential)

M. Water flows (into GC) by osmosis/down WP gradient

N. GC becomes turgid

O. Inner walls move apart/pore opens (because outer walls are thinner than inner)

(Max. 9 if no diagram) **10 marks from the available 15**

8.

A. Leaf can orientate itself to trap more incident light;
B. large SA to trap more light;
C. cells have large numbers of chloroplasts.
D. palisade mesophyll cells on top;
E. thin to allow rapid diffusion of gases/short diffusion path;
F. air spaces to allow rapid diffusion gases.
G. well developed Xylem support;
H. and water supply;
I. well developed phloem to remove products of Photosynthesis.
J. waxy cuticle reduces gas exchange;
K. stomata for gas exchange.
L. guard cells can close stomata (to reduce transpiration)
M. palisade mesophyll cells air spaces between to increase SA for gas exchange/orientation.
N. moist cell surfaces for gas exchange.
O. Chloroplast movement.
P. AVP.eg.thin cell walls to reduce diffusion distances, cytoplasm in cells pushed to edge of cell to reduce diffusion distances/transparent cuticle/vacuole.

10 Max